Waiting Games: innovation impasses in situations of high uncertainty.

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What are waiting games?

Two companies competing in the same sector of sustainable energy technologies, having developed a novel technology, and both waiting for the other to make the first move and introduce the innovation, which would present the first and best opportunity to really learn about public acceptance of the innovation.

A start-up venture in the medical devices sector waiting for established companies to invest in the early phases of the development of a new demonstrator; these companies waiting for the start-up to demonstrate the reproducibility of its demonstrator.

A company in the emerging field of nanomedicine waiting for regulatory decisions of the traditional organizations mandated to make these decisions, with the latter waiting for the new technology to stabilize so that its risks and benefits can be assessed…

The above sketches refer to situations in which technological innovation has reached an impasse: one side waiting for the other to make an important move without which this party cannot move on. The challenge for innovation has shifted from meeting uncertainties to breaking through a waiting game. The topic of 'waiting games' – or technology impasses - has not been addressed in the innovation literature, while it is clearly important to understand the phenomenon, and to be able to do something about it. We call this a waiting game because it occurs over and above the strategies of individual actors, even if there is general acceptance that the technology is promising and innovation is necessary.

Radical or architectural innovation processes are full of uncertainties and unknowns, and are

accompanied by high expectations. To create new products and services, new values and social relations, actors have to come to terms with these aspects and develop strategies accordingly. There is an additional challenge in that the structure of this situation can lead to innovation impasses where little of significance happens because actors wait for others to make a first - and potentially *risky* - move. This special issue explores the variety of waiting games and their dynamics, and offers suggestions about breaking through them.

Waiting games, with their first mover problem, are strategic games in the real world (Scharpf 1997). To overcome them requires a transition at the collective level, amidst high uncertainty. The waiting game may be linked to the design process itself, were cognitive/conceptual lock-in prevents breaking out of an incumbent technological development pathway into fresh and novel areas. Another form of waiting game is linked to existing technologies like fuel cells which remain limited to niche applications, and have difficulty breaking out of them, even when there are strong expectations (Bakker et al. this issue). The papers in this special issue address the variety of waiting games, mostly among the actors involved in developing a new technology, but also linked to a "wait and watch" attitude of regulators (d'Silva et al.). Le Masson et al. ask the important converse question, why are actors in the semi-conductor industry not locked into waiting games.

The contributions

The special issue provides five contributions, exploring the emergence, avoidance and management of waiting games in a variety of innovation contexts. Bakker et al. provide insights into the emergence of the hydrogen fuel cell technology waiting game, showing how actors' rhetorical 'expectations races' influence the emergence of a promising field. They highlight that, for the hydrogen fuel cell case, the large disappointments following the initial large hype has led to fuel cells being relegated to the trough of disillusionment where they are

doomed to waiting games. They offer advice for expectations management to avoid waiting games that are connected to hype/disappointment dynamics. Parandian et al. continues the theme on sociology of expectations for the field of organic large area electronics and nanotechnologies, showing how the dual dynamics of promising can lead to waiting games. They emphasise the need to articulate the expectations and visions of suppliers and users of the potential innovations as a means to reduce the possibility (or mitigate the effects of) waiting games. D'Silva et al. provide a case where waiting games were a high possibility but have been avoided (so far) through the unlocking of a dominant regulation regime. They show how an innovation impasse in nanomedicine would have ensued if the traditional wait and watch strategies of legislators and regulators had been followed. The case provides insights about how waiting games were avoided, but also reveal management insights through the notion of institutionalising what Le Masson et al. have dubbed "unlocking rules". This notion of unlocking rules is elaborated in the two final contributions.

Agogué et al. takes the bull by its horns, by developing management tools to assess and break out of innovation impasses that lead to waiting games. They draw on two cases of regional clusters focusing on two different innovation issues, where there is large investment and a high demand for solutions, but stagnant innovation processes. They use this as an opportunity to explore the fundamentals of lock-in and provide a conceptual framework based on three types of innovation pathways. This conceptual framework allows an assessment of the innovativeness of search processes in these clusters as well, in conjunction with other tools based on design theory, being applied to unveil previously unarticulated innovation pathways.

Le Masson et al. pose the question, Why aren't the actors in the semiconductor industry locked into waiting games? The answer to this, they propose, is the regular articulation and design of collective expectations along with mechanisms for unlocking the socio-technical configurations within a particular design regime. To understand how the dominant design

regimes and emerging design regimes (niches) interact during transformations in the semiconductor sector, the article contrasts two models of regime in transition: (1) the classical model of evolutionary niches which suggests misalignments between rules and a competition between niches, and (2) a second model based on unlocking rules supporting collective work on a structured set of emerging technologies. This second model is illustrated with a case study on the International Roadmap for Semiconductors (ITRS).

Emerging themes and research perspectives

Each paper offers insights that both contribute to several issues of contemporary studies of innovation and provide a platform for further investigation. We describe these themes in the following drawing exclusively on the contributions in this special issue.

(1) Shared narratives of the future can lead to waiting games.

Bakker et al. propose that hype related to the rhetorical expectations race provides a temporary niche/bubble allowing time to build ties – reinforcing the classical logics of promissory narratives acting as an engine that powers innovation. Similar to Agogue et al. and Paradian et al., they suggest that hyping as a strategy to align actors and power innovation, is a risky affair since the niche created by the hype in the incumbent design regime may collapse over very short periods of time. This was the case for hydrogen fuel cell technologies, with the consequence that those who focused attention on the rhetorical expectations race suffered from the collapse of the hype. They propose two strategies:

- Modest promising, which provides longer time frames to build ties with less destructive collapses. However they argue that there is little incentive for individual actors to remain modest, though there IS a collective incentive – with rewards in the

long-run (thus a call for expectations management at the meso-level of industrial consortia)

- Rapid use of the bubble and the resources it provides, that is to match rhetoric with activities in an attempt to create more stable networks that can "weather the storm" if and when the hype bubble is to collapse.

The danger, they posit, is that if you do not follow one of these two strategies, a promising technology may fall victim to waiting games (post-disappointment) and lie in the trough of disillusionment for some time, during which the competencies and knowledge accumulated during the hype may reduce. They end with detailing how some firms attempt to maintain the knowledge base on hydrogen fuel cells through maintaining the positive elements provided by the hype through the continuation of small R&D projects whilst waiting for the promising technology to leave the trough of disillusionment, a clear example of a waiting game leading to innovation impasse.

Parandian et al. reveal the paradoxical effects of diffuse and open ended promises which are powerful in policy discourse, but which may hinder the realization of these promises. Innovation actors are reluctant to invest in concrete developments because the promises are open-ended and demand is not articulated. This is a structural issue and leads to waiting games in which actors are entangled. They argue that there are two promise dynamics (1) those of big open-ended promises (Umbrella promises) and (2) more concrete promise requirement cycles - they are not independent and that one can speak of dual dynamics.

> "Expectations are important because it is through them that future value of technological options are articulated and to some extent become stabilised"…
> "Expectations, when shared, allow some coordination and there are now attempts at joint coordination of emerging technologies and their future application"

But as they (and Agogue et al.) argue, when a vaguely defined umbrella promise[1] is widely accepted – and sometimes blackboxed – they can function as a protection, but also can lead to dual dynamics which act as a disincentive to innovators and the emergence of waiting games. They offer a solution, by suggesting that socio-technical scenarios and interactive workshops (combined under the banner of constructive technology assessment) can provide a means of understanding the processes and patterns which actors enact, which lead to waiting games (stimulating reflexivity)

Agogué et al. reinforce this by revealing, what they have dubbed as situations of "orphan innovation", where shared narratives actually correspond to fixations and where promises can be misleading. They unpick the locked-in narratives of the future by using the entrance point of design regimes, they explore the relationship between the repertoire of concepts in the community, the knowledge that is present, and the design paths that connect the "unknown", the imaginary, and the known. Their findings show that applying design theory in workshop settings can act as a tool to support reflexivity of the designers on their own assumptions and practices as well as allowing the articulation of alternative narratives. The alternative narratives can act as a means of assessing the robustness of the reservoir of options and can also become new design paths themselves.

Le Masson et al. argue that "quality control" of expectations and how they shape the exploration process can be located at the level of institutions (such as R&D or industrial consortia). Through their striking case of the ITRS roadmap, they provide insights into the effects of quality control of expectations and institutionalized unlocking provide a means of serial-disruptive-design.[2]

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[1] Umbrella promises are a discursive phenomenon, creating narratives – such narratives fit into recent policy discourse

[2] Bakker et al. affirm this as a location for such management of expectations – that the collective / consortia level

(2) Managing the "unknown"

The unknown and its promises not only require a more sophisticated descriptive language, they also call for a form of management, that should be strongly collaborative and would deal with new objects: Bakker et al. suggest to *manage expectations*, and support more collaborative explorations between expectations enactors and selectors; D'Silva et al. underline that regulation can support innovation (and avoid waiting games) if it remains a place for collaborative probe and learn activities– so that the emergence and design of regulation should be managed and is not necessarily the contingent results of complex political games; Parandian et al. illustrate how some critical technical challenges should be considered as collective goods (such as encapsulation in OLAE) and managed as such; Le Masson et al. underline how the actors of semiconductor industry were able to collectively manage an ecology of concept.

The papers pave the way to new studies on the collective management of "the unknown" and they suggest that this management itself might be the critical resource for contemporary industrial dynamics. Managing a collective design space appears as managing a new kind of "collective good", a collective good that is no more related to limited natural resources but related to the (limited) exploration and creative capacities.

(3) New organizations for supporting the exploration of the unknown?

This management of collective exploration might require new actors and institutions. Le Masson et al. describe the International Technology Roadmap for Semiconductor as a college for the unknown, Agogué et al. suggest the emergence of "architects" of paths in potentia,

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is an ideal place to go for their strategy of moderate hyping.

D'Silva et al. describe a distributed, multiple-actor, diverse and experimental regulatory landscape able to design new regulations located at the micro, meso and macro-level. These actors would be in charge of unlocking rules, would question "umbrella promises" expectations and provide a forum for expectations management (including hypes).The contributions in this special issue relating to the creative process (Agogué et al. and Le Masson et al.) suggest that waiting games can be both the cause and effect of limits to the creativity of innovators. A new actor is needed, who need not be an innovator herself but would be charged with enhancing the collective innovation capacities. The studies in the special issue help to frame what the roles and features of such actors could be: They would maintain an "ecology of concepts", to regularly open "path in the unknown", to rejuvenate regulations, to support collaboration between "expectations enablers" and "selectors", to organize "innovation race" and "avoid expectations" races.

Taken together, the three cross-cutting themes we have drawn out from the contributions, to this special issue, provide an interesting perspective on industrial dynamics and socio-technical regimes. The contributions show that there are ways to improve expectations management and to create situations which are not conducive to waiting games. For actors who wish to create a productive industrial sector, governance system, or innovation avenue, the capacity to collectively explore, structure and regenerate the unknown and the imaginary is a going concern. In this way, management of innovation moves away from production regimes to design regimes (Le Masson et al.), where activities and performance will be oriented towards the expansion of the imaginaries and their quality control.

Conclusion

Waiting games are an element of disruptive innovation where uncertainty and the degree of unknowness is high. This special issue of TA&SM provides insights into how uncertainties

and unknowness can lead to waiting games, but each contribution has offered suggestions on how to handle, use or avoid waiting games. We hope that this issue will provide a nucleus for further academic and practical explorations of waiting games in potentially radical innovations.